



Universiteit Utrecht

Honey and Cats: The Performativity and Materiality of Embodied Knowledge

By Elisa Sá Pinto



Thesis Supervisor: Dr. Toine Minneart

Second Reader: Dr. Iris van der Tuin

Thesis submitted as partial fulfillment of the requirements for the degree of
Master of Arts & Society at Utrecht University

Utrecht, August 15, 2020

Abstract

In glassmaking, discursive and non-discursive forms of knowing and transfer are now shifting towards a new materialist turn. Materiality and performativity are co-constitutive of each other: glass, body, tools, and space. Glass studios of the past, used systems of apprenticeship since young ages to transfer intergenerational knowledge; they lived in these spaces, in the sweat and hard work. In today's society, material culture is developing towards new forms of alienation; We no longer *understand* the things we *use*, the processes behind, the *how* and most importantly *why* questions, the knowledge that rests in the fingertips, and ourselves. Losing communities of expertise, influence how craftspeople find themselves without apprentices to share knowledge. In artistic practices, we see a growing interest in developing and retrieving knowledge of the past, following traditional forms of knowing and experimenting with new digital technologies. This research aims to connect the complex structures of embodied knowledge, analyzing movement, touch, and experience, by diffracting matters related to the performativity of bodies. Following Baradian's concept of intra-action, this research reads interviews among glassmakers and experts in embodied practices through literature studies and conducted fieldwork of *knowers* in the *making*. I exercise a closer look at systems of apprenticeship, and what does it mean to transfer knowledge, proposing speculative approaches to glassmaking practices. This research analyses re-enacting embodied expertise, simulations practices of the past, the influence of language and narratives on glassblowers through the use metaphors, analogies and 'glass' recipes, visualizations of ephemeral practices, video recordings, and digital enhanced perceptual systems, the use of notation systems as a unified language, and sonification systems for knowing and transferring. Based on the research, transferring embodied knowledge rests in the validity and recognition of non-discursive practices, and urgency of creating universal languages of making, that portray the multi-sensorial *knowing body*.

Contents

Introduction.....	2
Embodied Knowledge.....	4
Tacit Knowledge	6
Knowledge Transfer.....	7
Methodology	8
Honey and Cats	10
Playing jazz, playing glass	10
Glass Matter, Matters.	11
Performativity and Materiality	12
The entanglement of technology and knowledge	14
The multi-sensorial knowing	17
Ways of Knowing.....	19
Movement.....	19
Touch.....	22
Experience	24
Ways of Transferring	26
Apprenticeship, re-enactments and simulations	27
Narrative and Metaphors	31
Visualizations and Notation Systems	35
Sonification.....	39
Conclusion	41
Bibliography	43

Introduction

Digital culture is shaping the way we perceive ourselves, others, and the environment. We are now shifting from physical to digital forms and losing our connection and drive for embodied practices. The gradient naturalization of human perception, constant digitalization of practices, and alienation of materiality is creating a barrier among our conceptions of knowledge and embodied knowledge. As we live in an era of experts or the end of experts¹, we have moved from a multi-media process mechanism into a one-media mechanism². Although we may inhabit in the era of knowledge fluidity, society's touchstone settles on being a *user*. As we move forward, digital technology aspires to expand our perception, enhancing the human experience and broaden our sensibilities - using inorganic perceptual systems³ - brings extraordinary ways of playing-with and questions the nature of perception itself.

Seeing one thousand videos and reading a thousand articles on glassblowing will not make me become a glassblower. The embodied knowledge in glassmaking lives in the tacit ability of remembrance and practice. It requires time, cooperation, coordination, and physical presence in the studio. The *craftpersonship* in embodied practices is a disappearing quality in contemporary society. Learning by doing seems to have entered a period of extinction. Most of the local expertise in embodied practices is arriving at a point where 'old' masters are now gone and with them, their knowledge. The withdrawal of embodied practices and rising digitalization is also shifting society towards a new form of alienation. After centuries of intergenerational knowledge transfer, we are now leading towards the extinction of 'old' practices as a collective body. In the contemporary field of Arts & Society, we can recognize experimental artistic production as a linkage between extinction and transference. The strong relationship between artists and communities allows them to create other

¹ Michel Serres's *Thumbelina* is a figuration on the millennial generation, which has access to all types of information and knowledge. With the overwhelming accessibility to information, where Thumbelina seems to know everything by using her thumbs, Serres questions the future of expertise, by asking "Is this the end of the era of experts?" Michel Serres, *Thumbelina* (2015).

² We have moved from a cognitive mechanism, the brain, that uses different types of mediums – the human senses – into a process mechanism, the computer, which processes and transmits information in one medium – the screen. See further Alva Noë. "Newman's note, entanglement and the demands of choreography: Letter to a choreographer." In *Transmission in Motion: The Technologizing of Dance*, by Maaïke Bleeker (London: Routledge, 2016), 228-236.

³ Maaïke Bleeker uses this terminology for systems of perception that are technological. See further Maaïke Bleeker, "Knowing as Distributed Practice: Twenty-first Century Encounters with the Universe" in *Transversal Practices: Matter, Ecology and Relationality*, *Studies in Material Thinking*, April (2007), 1-12.

means of thinking and becoming together. Art thus becomes an open-ended platform in the transmission of knowledge.

Through an understanding of the nature of embodied knowledge – expertise, memory, and transmission – and analysis of the craftpersonship in glassmaking, this research draws attention to the central debates on practices of knowing through the body. How can we use embodied memory to transfer knowledge of lost material practices? How does the glassblower's body *know*? How does it move on the glass studio? How can re-enactments engage local communities and act on knowledge transfer? How do we transfer experience and touch? How do we transfer techniques that are stored in the body? How do we position ourselves in the other's body? This research positions the individual learning body in a permanent state of being and becoming with the object's materiality. Embodied knowledge unfolds a set of invisible riddles and strings, as the hand moves to shape the glass, the glassblower becomes part of the object's existence – 'being as a thing'⁴. With this being said, this research proposes a multidisciplinary analysis focusing on the central concepts of embodied knowledge (craft, memory, and technology) and knowledge transfer (movement, touch, and experience).

⁴ Maurice Merleau-Ponty uses this expression to translate the mutual relationship between subject and object. The glass blower plays a game of invisible relations with the melting glass, as the medium moves from a liquid to a solid state. See Maurice Merleau-Ponty, *The Phenomenology of Perception* (Abingdon, Oxon; New York: Routledge, 2012).

Embodied Knowledge

We have become the thing on which we are working⁵.

To understand is to experience the harmony between what we aim at and what is given, between the intention and the performance – and the body is our anchorage in the world⁶.

We perceive the world through our material presence. Knowing by virtue of the body measures the type of knowledge that remains in the fingertips, it is in itself, invisible and inexplicable. In *The Phenomenology of Perception* (1962), the philosopher Maurice Merleau-Ponty claims the world is perceived to be intrinsically performative, as the agents perform their own experience and understanding of the surrounding, of the things and others. Based on experience, we attribute meaning and form to non-discursive ways of knowing. According to Merleau-Ponty, the body is the material in which we perceive the world:

We have learned to again sense our bodies; we have discovered, beneath objective and detached knowledge of the body, this other knowledge that we have of it because it is always with us and because we are bodies. It will be necessary to similarly awaken the experience of the world such as it appears to us insofar as we are in the world through our bodies, and insofar as we perceive the world with our bodies. But by re-establishing contact with the body and with the world in this way, we will also rediscover ourselves, since, if one perceives with his body, then the body is a natural myself and, as it were, the body is the subject of perception⁷.

Embodied knowledge is a way of knowing through the body. In embodied artistic practices, such as glassmaking, the body carries information that cannot readily assume a verbal translation. It resides in the experience and touch, based on the individual agent, which is performing the medium. Embodied knowledge is not something that can be deleted from the body⁸, as it is acknowledged in the flesh of our bodies. The sensorial experience of the word assumes a central position, cumulative and practiced over time. It carries a timelessness within practices of repetition, constancy, and memory. Only by

⁵ Richard Sennett, *The craftsman / Richard Sennett* (New Haven [etc.]: Yale University Press, 2008): 174.

⁶ Maurice Merleau-Ponty, *The Phenomenology of Perception* (Abingdon, Oxon; New York: Routledge, 2012): 144.

⁷ *Ibid.*, 213.

⁸ It is important to stress here that although it is not commonly erased from the body, there are some exceptions, especially if we consider scenarios of trauma and motor and cognitive disfunctions.

remembering, the body can know. The memory of the body, procedural and implicit, stores the body's experiences. It is reflexive and individual, performed in rituals of handling matter.

The ethnographer and sociologist Erin O'Connor places embodied knowledge in the ability to perform cognitive and corporeal readings of a medium. O'Connor developed the research on craft by learning how to blow glass, which translated into questioning the role of meaning in embodied practices. Combining learned and unlearned skills made it possible to ask how the glassblower reads glassblowing⁹. O'Connor argues that glassblowers move from a position of serving the instrument to *becoming* the instrument itself, as the blowpipe becomes an extension of the body¹⁰, and the movement of attention refrains to a subsidiary awareness¹¹.

The argument lies in the nature of the conscious body, which by making the technique explicit sends back the object's focal awareness into unconsciousness¹². To be able to work with glass, you need to learn how to read the glass and perceive the instruments as part of the body itself. The 'body was blind' until O'Connor learned how to read the glass and control the processes of glassblowing. Only through unraveling the meaning of the body, such as the hand coordination and body movement, she was able to relate touch to form. Understanding how the body moves in space, learning the choreography of producing hot glass vessels, lies in comprehending the medium's materiality and effective coordination of the body as a whole and the relationship between parts, such as the arms, hands, and fingers¹³. The hand micro-gestures, the touch on the blowpipe, the sense of temporality and space, the full engagement, and the active anticipation are all comprehended in the dynamic relationship between subject, object, and environment¹⁴. To understand the importance of shaping explicit and codified knowledge into an implicit dimension, we first need to explore what tacit knowledge means.

9 Erin O'Connor, *Embodied Knowledge: The experience of meaning and the struggle towards proficiency in glassblowing* (London, Thousand Oaks, CA and New Delhi: Sage Publications, 2005), Vol 6(2): 183–204.

10 In interview with glassblower Bibi Smit, she shared how 'the blowpipe becomes your fingertips'; more than an extension, the tools become part of the body itself. See Appendix 2.

11 O'Connor, *Embodied Knowledge: The experience of meaning and the struggle towards proficiency in glassblowing*, 188.

12 The process of converting information and practices into the tacit dimension, is what the sociologist Richard Sennett calls 'embedded knowing'. Sennett, *The craftsman / Richard Sennett*, 50.

13 Erin O'Connor, "Touching tacit knowledge: handwork as ethnographic method in a glassblowing studio" *Qualitative Research* Vol. 17(2) (2017): 217–230.

14 *Ibid.*, 218.

Tacit Knowledge

The term 'tacit knowledge' was introduced by the polymath Michael Polanyi¹⁵. The nature of tacit knowledge is understood as *untellable* and *personal*. How can we know if we cannot explain what we know? For Polanyi, tacit knowledge is not possible to be uttered in general terms, yet it does not mean that it cannot be articulated at all¹⁶. By questioning the opposition between objectivity and subjectivity, he places knowledge to be personal, as it lives in practical ability and is context-dependent¹⁷. By focusing on the *know-how*, rather than *know that*, tacit knowledge unfolds the dynamics of human bodily experience.

Glassmakers undergo a palpable difficulty in translating what they are doing into words. Driven by embedded practice, it becomes part of the glassmaker's body, moving away from consciousness into a tacit dimension. Sometimes, one can experience the possibility to learn something by watching the gaffer move with the glass, move the hands around the pipe and the body in space. This knowledge that lies in the body is possible to be made explicit, to be told, even if it does not happen. By contrast, when the gaffer is shaping the glass, the temperature is only accessed because of their experience and level of expertise to measure time and conditionals. It cannot be told.

By discussing the possibilities of what does it mean to know and the nature of knowledge itself, I focus on the possibilities of transmission and evoking experience and touch. In embodied knowledge practices, we are presented with two different types of knowledge and exchange. In the first instant, what we can tell is envisioned to be translated and transferred between subjects. On the other hand, what is not possible to be brought cannot be transferred, and thus I will argue possibilities for actively engaging and evoking sensorial experience. Focusing on the performativity of bodily actions, rather than verbal explanation, what remains in the tacit dimension queries us to rethink how we share and call forth analogous practices.

¹⁵ See also Michael Polanyi, *Personal Knowledge: Towards a post-critical philosophy* (London: Routledge & Kegan Paul Ltd, 1958).

¹⁶ See also H. M. Collins, *Tacit and Explicit Knowledge* (University of Chicago Press, 2010).

¹⁷ Neil Gascoigne and Tim Thornton, *Tacit Knowledge* (Routledge, 2013): 5.

Knowledge Transfer

In embodied knowledge, we perceive the body as the knowing subject and *doing* without representation. I acknowledge that bodily practices, such as glassblowing, cannot be transferred, only developed or evoked by each individual body. How the gaffer embodies knowledge is re-enacted in the ability to perform and know through doing.

Through practice, embodied knowledge is commonly agreed to be transferred by observation and imitation. In archaeology studies about pottery technology, the relationship between embodied knowledge and transfer can be traced back to the Bronze Age. According to Joanna Sofaer and Sandy Budden, knowing through the body is not possible to be unlearned since it is incorporated, accumulated, and practiced over time. The repeated performance acts as a ritual of passage from apprentice to master in the pottery production, unveiling the intergenerational exchange. The role of close kin in knowledge transfer is essential and determines the continuity of pottery knowledge.

The evidence speaks to a structured system of apprenticeship, which required a series of social relationships to support the development of potting expertise. These relationships include those constructed between novice and master potters visible in the 'mixed message pots,' as well as potentially complex extended support networks that underpinned ceramic production¹⁸.

The ways of learning, being formal or informal, have an impact on the results produced by the young pupils. Where there is less chance of error in scaffolded education, they are more likely to have little chance for innovation. However, the more opportunity provided to experiment, evoking independent trial and error, also produces more error¹⁹. In this sense, learning a technique is correlated with knowing, experimenting, and finding creative ways to work with the medium. For Sheila Kohring, knowledge systems and accessibility are mutually connected in community building. From embodied individuals to communities of practice, material, and locality unravel the interrelationships among

18 Joanna Sofaer and Sandy Budden, "*Many hands make light work: potting and embodied knowledge at the Bronze Age tell at Szazhalombatta, Hungary*" in *Embodied Knowledge: Historical Perspectives on Belief and Technology*, Stig Sorensen and Rebay-Salisbury, 125.

19 Ibid., 124.

objects, bodies, and knowledge²⁰. Therefore, how one transfers and incorporates knowledge is connected to the bigger network of intra-relations. Acknowledging the invisible strings of knowledge transfer brings to the surface how matters of practice, through repeated performance, matter.

Methodology

The research was conducted through a multi-method approach. For collecting the data, initially, I visited six glass spaces in the Netherlands: Bibi Smit, Rietveld Academy, The Glassworks Leerdam, Nationaal Glasmuseum, Royal Leerdam Crystal, and Glasblazerij de Oude Horn b.v. The goal was to shed some light on private and public institutions, by understanding how they operate and communicate, and to see the studios and meet the glassmakers. Each of these glass studios works in various ways, although they all share similar views on their practices. The research limitation was affected by the current health crisis since contacting other studios was not possible due to being closed or unavailable. Later on, I visited and met Fabio Tagliapietra, Igor Balbi, and Giancarlo Signoretto at Vetreria Artistica 4 Glass in Venice, which made clear that Murano's traditional glass practices are in extinction nowadays and falling into mass production, moving away from the intergenerational exchange of knowledge. To identify various thinking processes among experts in embodied knowledge among different disciplines, I conducted eight in-depth interviews with Bernard Heesen, Bibi Smit, Jens Pfeifer, Jessamy Kelly, Marinke van Zandwijk, Maaïke Bleeker, Roger Kneebone, and Sven Dupré²¹, and discussed topics with Maikel Kuijpers, Lisa Naas, Fernando Quintas, and Teresa Almeida. Furthermore, I conducted an internship at Bibi Smit's glass studio for three months, where I developed arts-based research whilst learning glassblowing techniques (apprentice level). I recorded conducted fieldwork in the forms of field notes, videos, and photographs. Much of the learning process was only possible by learning through *doing*.

This research uses the method of diffractive reading for analyzing the data retrieved from the texts, field notes, and interviews. The strategy of diffraction urges for thinking within, situating myself inside

20 Sheila Kohring, "Conceptual knowledge as technologically materialised: a case study of pottery production, consumption and community practice" in *Embodied Knowledge: Historical Perspectives on Belief and Technology*, Stig Sorensen and Rebay-Salisbury, 109.

²¹ A list of interviews, with a topic list and transcripts can be found in the Appendix section.

the research. Looking for patterns of diffraction rather than difference aims to see what was not there before, but that is intra-related in dynamic agential entanglements²², as we read 'through one another'²³. The content of this analysis is divided into three chapters enlightening the crossing paths of embodied knowledge and knowledge transfer in glassmaking practices.

Glass Matter Matters dwells into the conceptualization of matter, materiality, and performativity. Following a sharp critique of representation and discourse-matter hierarchy, Karen Barad's proposal of performativity and material-discursive practices places matter and discourse in an ongoing intra-action²⁴. By understanding their mutual influence and association, I propose to analyze the implications of language in glassmaking, how it is perceived in the glass studio, and what types of communication glassblowers use to communicate glass knowledge.

In the following chapter, the analysis is focused on the movement, gesture, and touch in glassmaking practices. *Ways of Knowing* positions the body as a whole and examines the reflexivity and subjectivity of knowing through the glassmaker's body. By analyzing the interviews of glass professionals against studies on movement and dance, I propose to think practices that reside in the tip of the fingertips and question how does the body knows. Interdisciplinary practices are called upon to think about movement, gesture, and embodiment.

Ways of Transferring explores different forms in which we transfer knowledge, evoke experience, and use of tools. Firstly, I analyze the role of apprenticeship, re-enactments, and simulations as a way to transfer embodied knowledge. Secondly, I propose a look at forms of evoking experience – the use of narrative, instruction, and storytelling. Thirdly, I analyze different systems for understanding movement, rhythm, and data – visualization tools, notation systems and sonification. These tools intend a speculative approach towards ways of teaching and learning glass, questioning how embodied ways of knowing are shared, understood, and - perhaps – lost.

²² See further Revelles-Benavente, *Material Knowledges* (2018).

²³ Karen Barad. “*Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter.*” In *Signs*, 28 (3) (2013): 801-831.

²⁴ Karen Barad introduced the concept of *intra-action*, as a substitute for inter-action, and understands agency as a ‘dynamism of forces’, rather than a property that entities can exercised. Karen Barad, *Meeting the Universe halfway : quantum physics and the entanglement of matter and meaning / Karen Barad* (Durham, NC, [etc.]: Duke University Press, 2007): 141.

Honey and Cats

Playing jazz, playing glass

Seeing a jazz ensemble is like becoming part of an act that exists on stage, performed by an ambitious and complex group of musicians. I have always heard that only those who *know* music listen to the contrabass, setting the tempo and rhythm of the song, becoming a constant in the music. The tempo is thus the full soul of engaged musicians that play in and within the rhythm, constructing variations and working together to build a perfect jazz harmony. The song becomes a particular play where the parts constitute and contribute to a whole, without missing their sense of individuality and identity. As the song continues, each one plays a solo that becomes part of something bigger.

Glassblowing carries a similar dynamic of exploratory artistic making. The film and documentary director Bert Haanstra produced a documentary on blowing glass, privileging us with a look at the hand and the metal, the body, and the machine. *Glass* (1958) is a short documentary about the glass town Leerdam in the Netherlands, it shows the dichotomies between glassblowers and glass factory. By exploring the dynamics of glassblowing, Haanstra produced a documentary that, like jazz, carries a sense of tempo, delicacy, and precision. The hands keep the moving pipe always rotating, with delicate touches of fingers that *know* and a mouth that blows fast and precise.

Alike the pianist and the saxophonist, the glassblower's knowledge inhabits the hand and the breath. Haanstra places the metamorphosis and fluidity of the material always in motion, engaging the glassmaker to move with it, becoming as one, being grounded at the moment, with the thing they are producing. The full engagement assumes a total awareness of the senses, where the hand feels the pipe gather, a mouth blows air creating a bubble inside the glass, the eye never leaves the moving shape, the glassblower can feel the smell of the paper burning while molding the glass and hears when the glass cracks.

In the factory, the movements carry a different nature: mechanical. The workers' function is to make sure the machines are correctly working, automatized, and functional. The hand is used to roll a cigarette, instead of leading the pipe of glass. The music is no longer live experimental jazz but an industrial sound. Haanstra is no longer portraying the poetics of engaging within the material but rather the mechanical utility of producing it.

The curious eye of Haanstra thus brings to the surface how one hand helps the other, as the body assumes a central position in knowing the material. The glass studio stages a performance of collaborative creation, making visible the invisible practices. Hence, the body follows rituals of preparation, acknowledging the position of the materials, instruments, and tools. Here, the collective character of the studio emerges, since the glassblowers work together as a team, they perform a dance only possible by practicing the timing and choreographic movement of one another. The molten glass is thus to the glassblower what the contrabass is to a jazz ensemble.

Glass Matter, Matters.

You have to be the glass to understand what is going to do.²⁵

I'm not making the glass do what I wanted to do. I'm catching it every time it's doing what I don't want to do.²⁶

In this chapter, I will introduce and discuss the performativity of glassmaking, the materiality and dynamics of bodies, tools, space, and the discourse relations in embodied knowledge. Focusing on the body as a central knower, and the glass as a central performer, I will argue the role of language and discourse in glassmaking and the emergence of understanding performative relations. In order to explore the ties of materiality and performativity as processes of meaning-making, I will analyze the relationship between glass technology and knowledge. Matter emerges from the relations of performance, moving away from dualistic thinking into a broader understanding of matter and discourse as mutually implicated forces. I will discuss how recent traditions on materiality relate knower and known, material and body, discourse and performance. The human body is a multi-sensory vessel, in which performativity entails an array of sensorial data processing. Knowing is thus stored in the tacit dimension of the body, unfolded on the realms of experience and without being easily translated or explicated. In glassmaking, the senses play a decisive role, as they perform knowledge through the body. Drawing from the glassmakers' interview analysis, I will further address how the sensorial data is processed by the glassmaker's body.

²⁵ Bibi Smit (glassblower, artist and designer), in interview with the author. Loosdrecht, February 2020. See Appendix 2.

²⁶ Marc Barreda (multi-media sculptor and glassblower), in interview with the author, 29 May 2020. See Appendix 6.

Performativity and Materiality

The glassmaker's performance resides in their ability to engage with the medium, the studio and the tools. In glassblowing, the knower performs within the glass, as they both move in space as one. In the quote above, the glassblower Bibi Smit expresses how body and glass need to move as one, as part of the same flow; in this sense, both are required to co-perform. This relationship is entitled to happen because glassblowing uses molten glass, in lava form, as one may call it, which morphs and is shaped by the gaffer's tools. In the same vein, the performance moves from a representational into a performative approach of all intertwined agencies. Scholar Shogo Tanaka draws his argument from Merleau-Ponty's concept of *body schema*. By reflecting on embodied knowing, he argues the pre-reflexive correspondence between body and world. *Body schema* refers to a 'corporeal system which enables habitual or skillful actions', what Martin Heidegger would call 'being-in-the-world' – the performativity of bodies, objects, and environment²⁷.

In that sense, the more skilled someone is, the less aware and represented they become. Moving from Representationalism and Cartesian dualism²⁸ to a performative physical understanding of the world, the body *knows* through living a concrete task that coordinates action and behavior transforming perceptual and cognitive systems. The glassmaker catches the glass, as the medium performs, into a different shape or into a blown vessel. By modifying the similar lava state into a form, the glassmaker is asked to perform and be performed, battling within organic intentions. Through refracting from representation, performance thus becomes the central form of the knowing matters – glass and body.

The feminist theorist Karen Barad argues the urgency of moving away from representationalism to performativity. Criticized by feminists, poststructuralists and queer theorists, Representationalism is a Cartesian product and western philosophy legacy, which distinguishes ontological frameworks by making distinct representation and what is represented. Barad argues that a 'performative understanding of discursive practices challenges the representationalism belief in the power of words to represent pre-existing things'²⁹. Challenging how language and discourse have too much power as

²⁷ Shogo Tanaka. "The notion of embodied Knowledge." In *Theoretical Psychology: Global Transformations and Challenges*, by Paul Stenner (Ontario: Captus Press Inc, 2011).

²⁸ Barad, *Meeting the Universe halfway : quantum physics and the entanglement of matter and meaning* / Karen Barad, 48.

²⁹ *Ibid.*, 133.

a form of knowledge production, dichotomic thinking between discourse and non-discursive practices, Barad proposes to move away from the binaries and dualities, such as nature/culture, body/mind, into a comprehensive and performative understanding of practices.

Performativity proposes returning to matter, the very change of nature. By questioning representationalism as separate entities and focusing on practices of representing, Barad acknowledges – reading through Michel Foucault and Judith Butler - the matter's dynamic characteristic. Knowing thus emerges from a direct relationship with the world's materiality. Herewith, performativity recognizes matter as an active participant. Reading glassblowing through Barad's text brings to light how the relationship between glass and glassmaker as co-constitutive.

Erin O'Connor argues how glass's matter becomes meaningful only in practice. Drawing from the Baradian intra-action concept, in *Inter- to Intracorporeality: The haptic hotshop heat of a glassblowing studio* (2015) O'Connor argues the intra-relations - gaffer, master, heat, glass, tools, assistant, and hotshop - in glassblowing as 'the dynamic symbiosis and simultaneity of becoming glassblower and becoming glass via hot relations'³⁰. Thomas Csordas proposes that 'such corporeal interstices of interaction, wherein persons experience themselves as extended in relation to and interaction with each other, constitutes intercorporeal meaning'³¹.

The glass studio performs and is performed in the intra-relation with other matters. The maker performs the studio – a stage – in order to be able to move from one point to another, moving the hot glass back and forward from the glory hole to the bench, to the annealer, to the kiln. Space performs a sense of tempo and rhythm with the glass, a choreographic dance of temperature, time, ambient, tools, heat, bodies. The studio is perceived to be 'as a metabolic dynamic of interaction, inhabitation and intrachange'. As O'Connor puts it:

The 'corporeal' of 'intercorporeality' is inclusive not only of other persons, but also of matter, understood not just as hot glass, but also tools and equipment, in addition to forces, notably gravity and centrifugal force in glassblowing, in which matter is. Thus, intercorporeality is not only interactions and interstitial meanings among glassblowers, but also those of hot glass,

³⁰ Erin O'Connor. "Inter- to intracorporeality: the haptic hotshop heat of a glassblowing studio" In *Studio Studies: Operations, topologies and displacements*, by Alex Wilkie Ignacio Farías (London, New York: Routledge, 2015): 116.

³¹ O'Connor. "Inter- to intracorporeality: the haptic hotshop heat of a glassblowing studio", 114.

tools and equipment though and within forces; non-human materials and forces are constitutive players³².

A 'vestige of factory culture', the studio glassblowing challenges the 'hot medium, but also articulates the collective dynamic with which hot glass became a studio practice via workshops'. Although the studio and the shop are connected in dialogue, they have different natures. Material and bodies are driven by conscious decisions as 'the studio-hotshop dyad enacts a social order in which the perception of the artist's intentionality can reign, mirroring an unwarranted dichotomy between mind and body'³³. Paraphrasing Merleau-Ponty, O'Connor notes that 'the glassblowers are like organs of one single intercorporeality, in which each person completes the other'³⁴.

As the glassblowers 'become intimate with the hot glass', communication and sensibility towards the medium urges strongly, reinforcing the hierarchy in the teams; each body anticipates the other's movement.³⁵ The quality of proficiency relates to how the body moves with the glass, in unison, attuned sense of tempo and synchronicity, as well as a shared material literacy³⁶. As the 'heat penetrates'³⁷, the choreography of glassblowing moves in space, a 'constellation of bodies in flux', from body to body, shaped with the wooden, paper and metal tools, fired with hot glass's metamorphosis and fluidity.

The entanglement of technology and knowledge

Techne and *episteme* are co-constitutive elements³⁸. Technology makes visible, quoting Martin Heidegger, 'whatever does not bring itself forth and does not yet lie here before us'³⁹. In recent

³² Ibid., 115.

³³ Ibid., 117.

³⁴ Ibid., 112.

³⁵ Ibid.

³⁶ Material literacy is understood here as the ability of 'reading' the material. See also A. Lehmann, "Material Literacy", *Bauhaus Zeitschrift* nr. 9 (2017): 20-27.

³⁷ Gaston Bachelard in O'Connor. "Inter- to intracorporeality: the haptic hotshop heat of a glassblowing studio".

³⁸ Technology comes from the word *techne* which unfolds a set of relations between poesis, to bring forward, and episteme, knowledge.

³⁹ Maaïke Bleeker & Iris van der Tuin. "Science in the performance stratum: hunting for Higgs and nature as performance" in *International Journal of Performance Arts and Digital Media* (2015), 235.

traditions, performance and performativity are both emerging and validating practices that were only approved by scientific forms of knowing. Paraphrasing Andrew Pickering, Bleeker and van der Tuin argue that by enlightening the networks of socio-material, knowledge is produced in the 'mangle of practice'⁴⁰.

In order to analyze the relations of glass technology and knowledge, where matter is called upon to perform, I will discuss the relationship between glass technology and knowledge production. Following the thoughts of Jon McKenzie, 'technologies have to perform or else', Maaïke Bleeker and Iris van der Tuin argue nature's request to perform – bodies and tools. Their analysis of the Baradian performativity through Posthumanist and New Materialism lenses positions humans as knowers by the direct relation with others, such as non-human entities, tools, materials, and other matters. They argue that by starting the research 'in the mangle', bodies and technologies are called to perform⁴¹. Relational materiality is thus comprehended where 'all entities achieve significance in relation to other', as stated in Latour, Callon and Law publishing's.

Understanding Barad's matter as a doing and agency as a matter of enactment, positions technology as a vehicle to see and to know. Seeing and knowing are linked in the intra-relations between the knower and known. Following to the postmodern literary critic N. Katherine Hayles, the human species is in co-evolution with tools and technologies. Her cognitive studies position the body in relation to the outside and inside as both construct knowledge. Foremost, 'human intelligence cannot be understood separately from the technology through which humans relate to their environments'⁴². Glass and gaffer are evolving through the relations they are both co-constitutive. The glassmaker learns how to blow by continuous practice placed over the years. As time passes, their knowledge seems to metamorphose into a skillful practice.

Considering that knowledge needs to perform, brings to the surface the pressure of such performance⁴³. By delivering a demonstration, the glassmaker connects the medium's dynamic practices with audience interest. As they watch the performance, asking how and what questions, the audience becomes an

⁴⁰ Ibid., 234.

⁴¹ *Techno-performance* explores the relationship between performance and technology, and more specifically effectiveness in performing technologies. Ibid.

⁴² Ibid., 244.

⁴³ Ibid., 237.

active part of the performance/show, directly influence the artist's behavior and movement. Refrained from language and representation, they assume a position of the presenter, explaining the processes, steps and tools. By doing so, it becomes clear that part of speech is in itself performed. In discussion with the glassmakers, it became clear that live demonstrations of glassmaking create added pressure to their performance. While they are working, a presenter talks over the full process, explaining rituals, tasks, the glass, the tools. Analyzing the interviews, it became evident how this discourse creates pressure for the glassblower to perform, as often specific makings are not even possible to explain⁴⁴.

Glassmakers co-evolve with the medium as the process turns to be a never-ending learning path. Glass does not allow them to sit still, to grow bored. It has a life of its own, which they share and are part of. The porous nature of mind and body, glass and tools, heat and furnace, produces an ecosystem of co-relations. They have co-mutated in something else. They become the rhythm of the glass. The glassblower Marinke van Zandwijk explained 'how to move with glass is based on what the material can do. How hot it needs to be, it's about the material. What my body needs to do is based on what the material is capable of doing in this pressure'⁴⁵. Knowledge and technology are co-constitutive, as glassblower Marc Barreda would have it:

[Glass] is completely tactile, and yet you cannot touch it. It's all about tactility but from a meter away. It's through the conduit of the tools. It's through the conduit of the different apparatus you're working to that you have to gain the knowledge. Clear glass is very different from colored glass. Red glass is very different from blue glass. Every time you introduce one of these factors, you're going to have to relearn the whole material⁴⁶.

Drawing from archaeological and anthropological studies, material culture aims to understand this relationship between bodies and materials. By questioning how objects and people relate, we are able to connect the processes of making and knowing. Reading glassmaking through material culture studies, aims to look upon how bodies connect with the material, the co-evolution and relations in the social networks, and identify learning processes printed both in the body and glass. Analyzing such

⁴⁴ When something breaks, the audience tends to comfort and express sadness, although for the artist's breaking something is part of the process.

⁴⁵ Marinke van Zandwijk (glassblower and artist), in interview with the author, 3 March 2020. See Appendix 7.

⁴⁶ Marc Barreda (multi-media sculptor and glassblower), in interview with the author, 29 May 2020. See Appendix 6.

artifacts brings us closer to recognize how entities learn with the things they make, and craftsmanship as a complex practice that surpasses technique or skill.

The multi-sensorial knowing

The body is a multi-sensorial vessel whose capacity and ability to perform glassmaking are primarily related to sensorial systems. One learns through the co-evolution with tools and technologies that are mediated by seeing, touching, hearing, smelling, and tasting⁴⁷. If they lose one sense, other ones come to help navigate the space they inhabit. Glassmaking knowledge remains in the ability to read and process sensorial experience.

I mediate sensing in glassmaking in the full engagement of the glassmaker, which can have different levels of awareness. Haanstra's documentary *Glass* is about perceiving touch as a way to know. Heat and sweat become part of the learning curve. The hands assume a delicate touch, rolling the pipe forward and backward, at different paces and strengths. The hand never stops moving, always rotating; it follows distinct speeds and tasks. One hand helps the other, without engaging with one another. In the interviews with glassmakers, it became evident how their hands are vessels of knowledge, never sitting still. The glassblowers shared how they always rotate any object that lies in their hands without being aware of it. The two hands follow a different task, that is performed in equal time, but slightly different speeds and touch.

When glassblowing, one cannot take the eyes out of the moving glass, because it will lose the centrifugal force, and change form. O'Connor's writings express her first contact with the glass, placing the reader in the studio itself. By transforming procedures into discourse, O'Connor explores the process, step-by-step, of blowing an incalmo vessel. In a multi-sensorial practice, 'colour is seen, felt and smelled'. Although working the [glory hole] doors is a hard and 'grueling job', it offers an opportunity to step into the making, by watching the process from close. What one sees goes beyond just watching the glass. An example is that watching color is part of knowing the glass' temperature, in order to mold with precision as the glassblower knows what is coming next. O'Connor writes:

⁴⁷ See further Maikel Henricus Gerardus Kuijpers, “*The sound of fire, taste of copper, feel of bronze, and colours of the cast: sensory aspects of metalworking technology*” in *Embodied Knowledge: Historical Perspectives on Belief and Technology* by Louise Stig Sorensen, Katharina Rebay-Salisbury (Havertown: Oxbow Books, 2012): 137-150.

I dropped the paddle onto the bench and ran to the glory hole to throw open the doors for the fused bubble, and continued to lasso the pegs, opening and closing, as they shaped and opened the bubble, flattening it into a wide, hollow disc that required that I leave the doors fully opened as they heated. Having never worked on a team, the intricate work between two benches was dizzying, as I noted in my field notes that night – the sounds, scents, sensations, and the total inhabitation by, within and of heat⁴⁸.

While the furnace sets the background sound that brings the glass to play⁴⁹, all the others that come after are mediated among all matters. When the glassblower shapes the glass with metal or wooden tools, it produces a unique sound. The metal tweezers will tinkle only when the glass is cold enough, meaning that it can no longer be shaped. However, when it is at the right temperature, the tool will slide it like butter on warm bread. It is essential to mention that the cold and hotshop have a distinct sound. In the coldshop where works such as cutting, polishing and sandblasting are done, sounds play a much more significant role in feeling the glass than it does in the hot shop.

The sensorial experience in the hot shop, for example, inhabits the personal body's intuition and sensation. The smell of burning wood molding the glass, the smell of the heat, the beeswax rubbed in the metal tools; all comes in form when working with molten glass. The glassmaker and professor Jessamy Kelly shares her experience in timing and following 'little patterns', as 'glass takes time and patience'⁵⁰. Because of these nuances, it is also commonly agreed between practitioners the blurred line defining craft and art⁵¹. Concerning glass relations to art, craft and technology⁵², the artist Jens Pfeifer argues that although glass is a technology, in learning glassmaking 'technique is not a goal but

⁴⁸ O'Connor, "Inter- to intracorporeality: the haptic hotshop heat of a glassblowing studio", 112.

⁴⁹ I write *play* here in a sense that when the glassblower works with molten glass, the metamorphosis of the medium allows to be shaped in real time, they move together, one teaches the other; as the glass only moves because of the furnace's heat, in a almost liquid state.

⁵⁰ Jessamy Kelly (glassmaker, head of Glass Department at Edinburgh College of Art), in interview with the author, 4 March 2020. See Appendix 4.

⁵¹ Craft and artisanal are different and context based. For Barreda, the word *artisanal* encompasses 'that there is a touch to the craft of something. There's something being brought to material or a process that is brought from some other form of knowledge, whether it be innate to the maker or whether it be through a series of researches and intentions'. See Barreda, in interview with the author. See Appendix 6.

⁵² See also Kokko, Kouhia and Kangas, "Finnish craft education in turbulence: Conflicting debates on the current National Core Curriculum" in *Techne Series A*: 27(1), (2020): 1–19.

a tool⁵³. In we can infer that the complexity of performing glass is thus related to the difficulty in understanding its materiality and own nature.

Ways of Knowing

In this chapter, I will argue how movement, gesture and touch are experienced by the glassmaker's body and how it is lectured. Placing glass as both technique and technology allows for a more comprehensive view on embodied practices of knowing since it positions the body in unique intra-relations between medium, tools and studio. Reading archaeological and dance studies, through the interviews with glass professionals, creates a conversation between disciplines whose primary focus is developing practices of movement and embodiment. I will reflect on the interviews focusing on technique, tools, learning processes, movement and experience, touch, and ways of teaching through positioning oneself in another's body. Knowing as a distributed practice is perceived to be embedded in the body, as it moves in space⁵⁴. I will discuss embodied knowledge as a collective action, the exchange between glassblowers, the collective memory and presence in the studio.

Movement

The viscous glass will sag unless the pipe is constantly turned. In order to get a straight bead, the hands have to do something akin to twirling a teaspoon into a pot of honey⁵⁵.

Glassblowers move in order to *know*. Analyzing the intra-relations of matter enriches the ways one learns a medium that moves. As stated before, knowing through the body - embodied knowledge - rests in the fingertips, the muscles, in the body's spatial-temporal experience, and in the ability to know by doing. When the glassblower gathers from the furnace, which is set at 1150°C⁵⁶, one moves using

⁵³ Jens Pfeifer (artist, head of Glass Department at Rietveld Academy in Amsterdam), in interview with the author, 24 February 2020. See Appendix 3.

⁵⁴ See also Bleeker, "*Knowing as Distributed Practice: Twenty-first Century Encounters with the Universe*".

⁵⁵ Sennett, *The craftsman* / Richard Sennett, 173.

⁵⁶ The temperature of the furnace is variable and mainly dependent on the glass chemical composition.

a set of rules, movements, gestures that need to be performed correctly. Movement is thus linked to understanding how the arms, legs and hands play a role in gathering⁵⁷.

Glassblowing inhabits the body's ability to read movement and rhythm. From the Greek *rhythmos*, derived from *rhein*, rhythm relates to the verb 'to flow'. The fluidity is encompassed in an ordered set of time, like a wave in the sea. In this technique, rhythm is central to perform, since the glass is moving in a viscous form. When rotating a blowpipe, one must consider the glass's temperature and accommodate the speed and rhythm to it. The medium is in charge of the movement, as it has an alive quality, which the glassblower follows or directs where it intends, or not intends, to go. As honey in a hot teaspoon, that just twirled a hot cup of tea, it requires a sense of care and being at the moment. Although, if you touch the hot glass or hot honey, you may not have the same result. One gets to know glass in the sweat, the tears, the blood, the exhaustion. The molten glass thus becomes an intricate, fluid, time devoting medium to work and to learn with.

The fluidity of gestures follows the gaffer's intention. If a movement is too sudden, for example, after gathering, the glass will metamorphose into the blowpipe. It is commonly agreed upon the glass community that working in the hot shop resembles a ballet. The bodies move in a way that 'nobody is talking, it is unnecessary, everything comes in time and you hardly have to look'⁵⁸. The flow in which they move synchronizes moving matters - bodies, glass and tools. According to Roman Kirschner, fluidity challenges to rethink knowledge mobility and material fluidity. By positioning metamorphosis as a way to look at language, knowledge and metaphors, he places fluidity in structures and meaning relations. In doing so, Kirschner aims to illustrate a continuous 'universal flow' of matter⁵⁹. This 'universal flow' is what continually moves in the hotshop, as the medium fluidity sets the rhythm, all matters morph in their relations. The bubble forms with the breath that shapes through the body, which

⁵⁷ If the arm is too high or too low, gathering too near or too fast, approaching the furnace by the side, all these intentions are impressed in the way the glass moves and behaves. As an apprentice, when I would gather glass without evenly rotating my left arm, the glass would fall out of centre and not be sufficient to work with.

⁵⁸ Bernard Heesen (glassblower), in interview with the author, 4 March 2020. See Appendix 1.

⁵⁹ Roman Kirschner, *The Coupling of Matter and Imagination in Fluid Ecologies* (Berlin, Boston: De Gruyter, Inc, 2017): 12.

moves on the stage, performed in the heat of the furnace. These fluidities of gestures are thus perceived in relational meaning matters⁶⁰.

The glassblower Bernard Heesen explained how his maestro⁶¹ always kept saying that glass needs to be fluid all the time, by shouting 'make it hot again!'. While the glassblower is able to do two things at the same time, each hand performs a different movement, rhythm and gesture, although they are linked by the hot glass, which they need to watch all the time. The glass needs to be moving, always hot, rhythmic, and constant⁶². By positioning heat and fluid glass as co-constitutive matters, the body needs to be able to deal with the hot temperatures⁶³, as you also know through it. It is in the burning almost sensation that the gaffer knows how malleable it is.

Rhythm assumes a central role as it sets the tempo in which all matters synchronize. For example, as an apprentice when gathering, both hands need to be rotating at the same speed for a few seconds, turn the blowpipe up at a slower pace, never stop turning, and then exit the furnace door at a horizontal level. Movement and rhythm determine the gather and the shape centered in the blowpipe. Failing to do so, is the first mistake in learning to blow glass. By looking at micro-gestures, the apprentice aims to know. In this sense, the body understands space and time through the fluidity of glass as it moves constant and in rhythm, which is shaped for each specific moment. Rotating a small piece inside the glory hole to make it warmer, is not the same speed as when one needs to 'flash'. The distance between furnace, glory hole, and bench also plays a role in how much time one takes to move from one place to another. All factors thus inform the gaffer in how they should behave⁶⁴.

For Sennett, rhythm, as understood through stress and tempo, is extended from the hand to the eye, as the craftsperson becomes more skilled. In the analysis of Erin O'Connor's glassblower experience,

⁶⁰ See further Mihaly Csikszentmihalyi, *Flow : the psychology of optimal experience* (New York : Harper [and] Row, 2009).

⁶¹ Willem Heesen, his father.

⁶² Heesen, in interview with the author. See Appendix 1.

⁶³ Interestingly, it is commonly agreed among practitioners that if you cannot tolerate the heat in the hotshop, you cannot become a glassblower.

⁶⁴ Bibi moves much faster when the piece is on full size, weighting around 20 kilos. Before, when preparing the colour and gathering, her movements are slower, they have little conversations, their bodies seem more relaxed, moving slower. But after achieving the full size, the heavy piece dictates in some way how they move. The talk is lower and less, only indicative, the body is in tension, the sweat, the blood, the heat becomes materialized. They both start communicating what they are doing, what is coming after, what needs to be done, more intensely. They both follow the hot glass.

Sennett explains how 'she is not counting how often; she wants to repeat breathing down the blowpipe, holding and turning it in her hands. Her eye, however, sets the tempo'⁶⁵. Setting the tempo thus enables anticipating how the body needs to respond, shifting movement's nature into a fluid state⁶⁶.

Understanding viscosity and efficient coordination support the control in gathering, according to O'Connor. She unpacks Paul Atkinson, Tim Ingold, Yves Ginard and Alfred North Whitehead writings on glassblowing, techniques, tools, materials, the physical body and the studio itself, and argues 'handwork in glassblowing is embedded within a choreography of materialities, including hot glass, tools, equipment, and others' which lies within 'another choreography' of 'the bones, sinews, muscles, and their gestures'. As Ingold explains, the rhythm thus 'creates form'⁶⁷.

Analyzing glassblowing through Whitehead's principle of process acknowledges how being and becoming are constitutive – 'it's being as constituted by its becoming'⁶⁸. *Bodily gestalt* is a terminology used by Atkinson, comprehends the body as balance, posture, and choreography. Placing glassblowing through this lens amplifies the body's awareness into a conscious state. O'Connor thus focuses on the handwork and differentiated coordination (movement of the body, hands and the bench), the spatial-temporal dimension of the hands right/right, slow/fast, repetitive and brief, as well as, the relationship between tools and social meanings⁶⁹.

Touch

Gaffers *act* the glass through practice and *know* through accumulated experience. As discussed in the previous chapter, glassblowing is a multi-sensorial practice, which cannot be disassociated from the studio's physicality. Haanstra's documentary gives excellent attention to the hands rotating the blowpipe, using the tools, the soft and controlled touch and movement. Sensorial knowledge has

⁶⁵ Sennett, *The craftsman* / Richard Sennett, 176.

⁶⁶ As an apprentice, the more I was aware of what was coming next, it made movement smoother and less harsh. Knowing is necessary to be able to understand how the body should behave in the next seconds when blowing. As an example, initially when I forgot to rotate my left hand, a try to compensate by rotating faster after, only made it more out of centre. After, I was able to compensate how my body should be positioned, which made the movements less strict and more fluid.

⁶⁷ O'Connor, "Touching tacit knowledge: handwork as ethnographic method in a glassblowing studio", 224.

⁶⁸ *Ibid.*

⁶⁹ *Ibid.*, 227.

gained particular interest in recent encounters between such different disciplines. The hands encompass knowledge that cannot assume a verbal and written form. The craftsperson, for their unique quality of working with hands, stores details, and data necessary to produce what was designed.

In glassmaking, touch is a practice of knowing. However, it is not a direct way of knowing, as the gaffer cannot touch the glass when it is hot. The glassblower understands through touching it with the tools. As an example, when making a marble, the tweezers touch the glass to shape the form. One cannot understand the strength applied, the delicacy and movement coordination by looking at a gaffer. Only in practice, one can feel and therefore *know*. It resembles shaping a caramel with a butter knife when it is half melted away, except you cannot feel the temperature that is scorching the hand that holds the tool.

Remembering how touching felt is determined through experience. This unconscious memory is stored in the body. The experience is relational, as it shapes in different spaces, glass's composition and tool materials. Experience is connected through sensation and perception. Touching, feeling and experiencing become one in the intra-actions of matter. The glassblower Marinke van Zandwijk relates her experience in working in different studios to understand how changes influence how the medium behaves. In the constant learning process and adjustments, 'the feeling is the most important. When the window is open, the glass is already different. When your furnace is colder, the glass is already different. For every one that goes to a different studio, you need to feel your ways again'⁷⁰. This shared idea is more apparent when the glassblowers worked in different studios and cultures. Although they share a common language of practice, one quickly finds nuances in how they experience the workshop. Ranging from the distance from the glory hole to bench, blowpipe diameter and length, furnace' shape; depending on what and where is being made, many details become visible, keeping the body in an ongoing adaptation process. The blowpipe, for example, is felt differently if its diameter is similar to a pen or wine bottle. Moving may feel very different; And thus, knowing the tool needs to be reintroduced and learned.

⁷⁰ van Zandwijk, in interview with the author. See Appendix 7.

Experience

Practices of movement are developed through the enactment of experience. In dance studies, human behavior and experience edit how performers become co-authors in the production, as their bodies search for meaning in the movement. Analyzing the repertoire of Pina Bausch, the choreographer Norbert Servos argues how the dancers/performers draw their individual experiences in producing - and reproducing - pieces. Body knowledge transcends technique. He discusses how technique defines dance, but dance is not defined by technique. In the words of Bausch, dance 'has to do with a certain kind of awareness, a certain inner, physical attitude, and extreme precision: knowledge, breathing, every tiny detail. It always has something to do with *how*'⁷¹. Being aware of the movement and experience is necessary for making the body surpass a tool. It becomes a vessel of meaning, memory, and detail.

Every person involved in creating a piece stores a vast wealth of detailed information in his or her physical and mental memory and knows about the system of their complex connections. Only those who know how to create this complex richness and its interactions can revive the spirit of a piece⁷².

In glassblowing, experience, individual and collective, is a practice of knowing. Reading dance and glass knowledge through one another, mirrors patterns of sameness while diffracting patterns of body awareness. By looking at the glassblower's body through dance lenses, I argue that conscious forms of embodied knowing transpose meaning in practice. Knowing is mediated between the relationship between individual experience of the gaffer, as well as tools and other bodies. Seeing and feeling are intertwined in practices of experience. Through experimenting with the medium and exchange of ideas, glassblowers develop powerful glass knowledge and ephemeral archives.

Individual experience in the hotshop is based on the 'complex practice' of experimentation. The medium's personal experience connects feeling, seeing, doing, and knowing. As an apprentice, I saw/understood the process and steps needed to shape the glass by using tweezers, which required a soft and fast movement. Later, when I used the tools, I started to understand/see as I felt it in my

⁷¹ Sabine Gehm, Pirkko Husemann, Katharina von Wilcke, Tanzkongress Deutschland. *Knowledge in Motion: Perspectives of Artistic and Scientific Research in Dance* (Bielefeld: Transcript, 2007).

⁷² Ibid.

fingers. To further develop this idea, experimenting is a way of knowing and discovering, making visible 'the uncanny ability to pick out what is odd, wrong, instructive or distorted in the antics of one's equipment'⁷³, according to the philosopher Ian Hacking. He argues that image formation, for example, engages the sense of touch rather than sight⁷⁴. In this sense, seeing and visual sight have different natures. 'I see' is commonly used to transcribe an understanding of a particular subject or idea⁷⁵. Glassblowers learn the medium through processes of experimentation when intending to do something else and going wrong – the so-called 'happy accidents'. They use that movement to see how the medium shifts and assumes uncanny forms. Experimentation serves as a way to discover and explore what was not possible before – that to be a technique or another type of producing the same method. The alive quality of glass unravels other truths, languages and poetics, inviting gravity to come and play.

Collective experience inhabits the hotshop's complex and untellable performance of bodies. The actions, movements and exchange between glassblowers are embedded in the experience as a whole and of many tiny parts. Presence in the studio acts as a stage of knowing as a collective since all members move to know. Fluid knowledge can also be perceived as inscribed in the body through generations of glassmakers, since knowledge is passed from one to another, changing, metamorphosing, and assuming a fluid dimension. Collective experience is thus a rather organic form of knowing – in togetherness (amongst generations and peers). For glassblower Marc Barreda, intergenerational exchange influences glass knowledge, as it passes from one generation to another, craftspeople are 'living and breathing' since they were born. Barreda believes that this transfigures into a 'fluid view of the material', and *change* becomes a quality, always in evolution; such as language, glassmaking is unraveled in the 'little nuances' that are 'always different'⁷⁶.

It is worthwhile to notice that a significant difficulty in embodied ways of knowing is grounded in the inability to write about movement, touch and experience. Although I tried to do so, writing and experiencing are too different in nature to be placed together and to fully grasp why we move, feel, or experience in a specific form. This is to say that what is being written lacks the full experience of it. Writing about eating fresh-baked bread in the morning and actually going to a bakery and savoring it,

⁷³ Barad, *Meeting the Universe halfway : quantum physics and the entanglement of matter and meaning*, 145.

⁷⁴ Ibid.

⁷⁵ Ibid., 52.

⁷⁶ Barreda, in interview with the author. See Appendix 6.

are farfetched realities. Even though the knowledge of craftspeople is often challenging to put into words, they decode it by creating forms of communication that are based on bodily language, using mainly sounds and gestures. They also find ways to put themselves in the body of the other, by developing analogies and metaphors, and shared experiences. To illustrate the body's positionality:

Yesterday I visited Bibi Smit glass studio. While we are driving in our way to take care of some affairs, she told me that once when lecturing, she had a class of new students, and they could not get through a technique since they were novices. She talked with one of the students and asked him if he had a cat. He said yes. Then, she told him: 'You have to imagine that the cat is coming to your lap and you are gently petting, following a soft and fluid movement, again and again'. After that, he was able to do it right, contrary to the others⁷⁷.

Because he had a cat and remembered what it felt, he was able to use that experience and transfer it into the blowpipe movement. If his cat was not affectionate, one that only runs away, he may not have understood it in the same way. Putting oneself in the position/experience of the other is thus understood here to be subjective. Whereas written forms of knowledge may lack through knowing and transmitting bodily actions, shared experience creates possibilities of knowing together. Looking at this, individual worlds become available through intra-actions among experience, touch and sensibility, and acute body awareness as well. If we consider that memory and experience go hand in hand since we can only recall experience because we remember, then the fact that glass has memory also needs to be taken into consideration: we could say that all memories matter. We can then infer that, in order to transfer knowledge, we need to create a generalized language for communication, bodily, written, and spoken, that acknowledges the entangled nature of the movement, touch and experience. In the next chapter, I will argue how ways of knowing shift to be transferred.

Ways of Transferring

Glassmaking approaches the body as a center knower of the medium. As discussed before, many approaches need to be taken into consideration in learning how to work with the medium. The relations of making, move beyond the body, metamorphosing into the medium, the tools, the space and the

⁷⁷ Fieldnote, 31 January 2020.

relation with other bodies. Knowledge transfer eradicates ways of knowing that move from one body to another. Glassblowing does not fit this profile. Its complexity asks for total awareness of movement, rhythm and tempo. In this chapter, I will argue how embodied knowledge transfer assumes complex forms by seeking a speculative approach to techniques of transmission and exchange between matters.

Apprenticeship, re-enactments and simulations

Apprenticeship is the oldest way encountered in practices of knowing through the body. A rich sense of knowledge is born just by looking at masters in practice, their ways of moving and struggles with the material. Temporality and expertise build the starting point of knowing. We can see what we know, but also know through continuously looking. It is commonly agreed that in the factory times, apprentices were asked to watch the masters work while producing simple tasks, such as wetting the paper and opening the glory hole door. The same goes for contemporary glass studios.

Feeling the furnace's heat and wet paper's steam gives the apprentice a possibility to better understand what needs to happen, in technical terms, for pieces to be performed and executed. As an example, the tools need to be at a certain temperature in order to perform properly. If they are cold, the glass will make a squishy sound, high pitched, transmitting what they require to be able to mold the glass without making it cold faster. If they are hot, metal slides through the hot glass like butter over bread. It should also be taken into account that when the jacks are being heated, it should not be done for long, as they will start fuming if the metal is too hot and will get damaged.

Seeing the master perform, entails great depth and focused attention, as we are able to see the knowledge of many. Performing glass rests in the intragenerational exchange, in the complex networks of bodies and matters, that move from one generation to another. Knowledge remains in the ability to read the master's movements and intentions. This is not to say that one cannot learn without seeing a practitioner, but rather that certain techniques and knowing the medium happens in different levels of engagement. Worthwhile to note that although one can learn glass by itself, the generational knowledge regarding techniques and glass knowledge rests in many networks of knowing bodies. Apprenticeship systems, hierarchical and structured, allow for novices to gain a rapid set of skills and read with others, which will increase what one can do. Watching expertise perform will not make an

apprentice a great glassblower but will allow us to gain a great depth of the medium's materiality and language.

While autonomy creates space for error and experimentation, traditional glass studios reflect their maestro's expertise on apprentices. In Murano, it is commonly agreed that novices *grow* along with the maestro's hands. On knowledge transfer among generations, they share their experience, technique, and, most importantly, *la vita* (their own life) with apprentices. They live through the other's doing and mouth. Life and knowledge are thus intertwined. We can infer that intergenerational exchange based on communities, creates a more in-depth learning process by being immersed in social and cultural networks.

The clinician Roger Kneebone proposes an alternative approach to learn practices of the past. Over many years, Kneebone has contributed to the body of knowledge about expertise, exploring interdisciplinary exchange and colloquiums about *making*⁷⁸. As he creates a conversation among experts and craftspeople, a different convergence of knowledge in embodied practices becomes visible, through exchange - show one another - between shoemakers, surgeons, potters, glassmakers, scientists, and so on. In finding how different disciplines find ways to feel their materials - to be flesh, leather, clay, glass, metal - his focused attention is allowing for learning how we *know* through our bodies, instruments and environments. Kneebone strongly argues how professionals in different fields have become experts 'in the vocabularies of touch'⁷⁹. Combining craft and performance, the value of repetition versus constant simulation, bodies in motion, and the *know-how* as they feel even if they cannot see.

Inspired by historical re-enactments, Kneebone and the historian Abigail Woods developed a study on how simulation-based re-enactment may get future generations in touch with endangered procedures⁸⁰ — bringing together retired surgical teams in an environment that stimulates the operating theatre made possible to perform an outdated procedure in a significant level of engagement and team awareness, which made visibly 'the complex unspoken communications, relationships and

⁷⁸ See further *The Art of Performing Science Symposium*, Roger Kneebone (Imperial College of London).

⁷⁹ Roger Kneebone, "The vanishing art of doing." *BMJ*, Vol: 364 (2019).

⁸⁰ Roger Kneebone, Abigail Woods. Recapturing the History of Surgical Practice Through Simulation-based Re-enactment (2014), *Medical history* 58(1),106-121.

interactions'⁸¹. In re-enacting knowledge 'that remain within living memory', their study understood all components of knowledge - environment, objects, gestures and bodies and reflected upon the importance of group norms and how ethnography brings the tacit knowledge to exposure. Kneebone and Woods strongly agree that simulation-based re-enactment (SBR) can help to capture embodied expertise of surgical expertise, as it records what until now was not possible to register, and that constructing the memories brought to surface how practices were 'enacted now and experienced then'⁸². In recording social practices in the operating theatre, they have selected contextual triggers and recreated rich sensorial environments, which allowed for the team immersion on the simulation and a powerful sense of place. With recording the social practices, they analyzed general behavior of team members, manifestations of technical expertise, the influence of personalities, hierarchical dispositions, and the social interactions on ways of working.

It becomes apparent the relationship of co-creation in apprenticeship, re-enactment and simulation. Co-creation is asserted to be a choreographic force of exchange. One hand helps the other; one body helps the other. The eye helps the hand and vice versa. These relations in apprenticeships determine how we perceived embodied knowledge to be performed between generations. It relates centuries of knowledge being transferred among matters, in the intra-action of living memories and records. The glassblower Bernard Heesen has been working with glass for over four decades. He learned with his father Willem Heesen when they opened a small studio in Leerdam, which previously had worked as a designer at the Royal Leerdam⁸³. He learned by making, over and over again. Since he never had a technical education in glass, his work mirrors no rules, and a lower sense of hierarchy, as he calls the people that work along 'colleagues'⁸⁴.

It is commonly agreed among glass practitioners that a good assistant should be able to know as much as the master. In apprenticeship, the assistance follows the maestro intentions and movements,

⁸¹ Ibid., 109.

⁸² Ibid., 120.

⁸³ At the time, designers and glassblowers were separated, one was not able to do both. This controversy fuelled William Heesen to build his own studio and furnace. Leerdam is a small town in the south of Netherlands, and is considered the city of glass. Founded in 1765, Royal Leerdam Crystal reputation was build on the work of designers: Hendrik Berlage, Andries Copier, Sybren Valkema, and Willem Heesen. Generations of glassblowers have a connecting relation with the factory. In the past years, many have collaborated with artists and designers to produce pieces and glass design series.

⁸⁴ Heesen (glassblower), in interview with the author. See Appendix 1.

anticipating and preparing what is coming next. That ability enriches the making process as the glassblower is acting in time with the hot moving glass. One step took longer, and the piece may collapse, and they need to start all over again. Time and knowledge walk hand in hand, performing many agencies within the theatre. In Kneebone and Woods's study, the surgeon and the theatre nurse perform a similar kind of dance as the nurse prepares the table with instruments in a specific order. In some cases, they are able to hand in the next tool without instruction. This kind of communication is also influenced by working time both spent together. For example, in teams that have been working for many decades the fluency of movement and actions is highly recognizable, as they learn to work with a personality, way of thinking and doing, as one.

In transfer, we must also consider the implications of hierarchy and agency in the making. Agency is reflected in the relations of all matters - glass, apprentice and glassblower. The primary agency positions the medium as the one to follow, to catch, to understand. In the studio, agency is thus performed between glass/glassblower, glass/apprentice and apprentice/glassblower. Hierarchical forms of knowing, place each agency at a particular position. Education in these systems follow guidelines and strict rules of procedures, maintaining different levels of flexibility. The glassblower Marinke van Zandwijk talks about how the masters let her be part of the studio by looking, wetting the paper and opening the doors. The repetitive tasks made it possible to learn more and further, doing step by step, and making many mistakes, over and over again. Van Zandwijk started very young and very enthusiastic about being able to see them by close and learn through small steps⁸⁵.

Knowledge transfer is thus generated in the repetitive process of making. Many glassblowers agree that learning glass is only possible through practice, engaging with the material and in the studio. Different nuances of apprenticeship can help the apprentice faster and support their development and enrich skills. By understanding hierarchical and agential relations, we can look at glass studios and grasp their work's essence. In doing so, simulations and re-enactment have a great opportunity of re-making certain practices and techniques and moreover, shed light upon the relations between agencies and matters – bodies, tools, movements, glass and studios. By reading glass blowing through a plethora of embodied practices of knowing becomes clear how different disciplines combine expertise and apprenticeship, moving knowledge from one body to another. Although the body does not move *per*

⁸⁵ van Zandwijk, in interview with the author. See Appendix 7.

se it appears immediate how knowledge is performed in transference and exchange; in the studio's physicality. Breathing glass through one another; being and becoming.

Narrative and Metaphors

Rethinking discursive practices asks us to find elaborate ways to express touch and experience of embodied knowledge practices. Touch and experience rest in the inaccessibility to be put into words or signs. It lives in the body's ability to feel and sense the world around it. Glassmaking thus assumes a complex crossroads when discussing discursive forms of knowledge, which rests primarily in the spoken instead of written language. We must consider how can non-discursive knowledge be evoked using words and expressive forms of telling stories and ways of performing and what are the boundaries of written language.

In writing glassmaking, one can find many instruction books that enunciate the procedures, techniques and steps to fulfill a form. Instead of representing, speculative thinking and expressive narratives assume a central role in how unique ways of writing and storytelling influence how one perceives and builds experience and touch. Consider showing and telling how to use a spoon too deep into a jar of honey. In this scenario, one must consider the size of the spoon, the amount of honey inside the jar and room temperature to better understand the honey's viscosity. Now imagine that the size of the jar occupies half the kitchen and is half-empty. These nuances play a role in how the instruction should look like, as other components are in play and one lacks experience. The verbs *use* and *deep* tell the reader what needs to be done but do not explain the process. These verbs understand how self-evidence both acts are, and lack in making the tacit knowledge, of taking a spoon of honey, visible into practice.

According to sociologist Richard Sennett, a flawed system of instruction leaves out important details. In apprenticeship, as an example, a sharp critique is built towards how in demonstrations, an apprentice's expectation of learning by osmosis leaves a burden as it assumes that one could simply imitate a master and be able to do it. This could happen, but many times does not provide enough support for understanding how specific movements are in one way or another. Sennett's principle of instructions serves as expressive guidance. By moving away from dead connotation, written language assumes an imaginative position and dwells into analogies, narratives, and metaphors to create

experiences or to evoke an experience into the other's body. In a critique of language as the foundation of a bodily movement, Sennett focus on 'how experiences of touch and grip' grant 'language its directive power'⁸⁶.

If making and knowing have unique natures, recipes should follow the same hypothesis. Inspired by Madame Benshaw's chicken recipe⁸⁷, I have drawn a recipe for making glass marbles. Making a marble is the first step most of the apprentices follow in the glass studios. It allows the novice to learn the fundamental steps and medium fluidity, gathering, centering, and shaping. Building a narrative upon metaphors acknowledges the reflexivity of each individual body and intends to focus on the essential objective stages of making a marble. The recipe goes as it follows:

Marble à la carte

Get acquainted with the spoon. Look for the shadow. Twirl the spoon of honey at all times!
Handle the heat. Careful, escape a burning house! Move as one. In the center lies the virtue.
Follow, do not control.

The first step is choosing a pipe to gather the glass. If a diameter is thin or large, rotating the pipe is different. A marble is a relatively small object and will require a thinner pipe. Get acquainted with the spoon (the pipe) makes sure the novice realizes the importance of why that chosen tool and how to feel comfortable. After, one needs to proceed to the glory hole to gather the glass at the end of the pipe. Looking for the shadow of the end of the pipe in the molten glass makes it possible to know how full or empty the furnace is. When the shadows meet, the end is touching the glass, and it is time to rotate to gather glass, just as would gather a spoon of honey. Glass is at 1150° C inside the furnace, which means will never stay still, just like honey. Being a glassmaker means to stand the heat, at least. While gathering and getting out is important to handle it, although if burning the nearest arm means staying far too long. Careful, escape the burning house! means it is time to get out.

After the glass is gathered at the end of the pipe, all matters are demanded to move as one; glass, pipe, and body. Both hands need to rotate the pipe evenly and understand the pace, which changes depending on the glass's temperature. Centering, as in the center lies the virtue, is what I have found the most

⁸⁶ Sennett, *The craftsman* / Richard Sennett, 180.

⁸⁷ Sennett, *The craftsman* / Richard Sennett, 189. Madame Benshaw taught Sennett how to cook this recipe.

demanding task. It requires concentration, hand coordination, and *knowing* which in the beginning will not exist. Keeping the glass in center and understanding centrifugal force is the holy grail of glassblowing, for beginners at least. The feeling is utterly different and needs to be slowly learned through small steps, increasing the size at a slow pace. Only when in the centre, one can take the jacks and start making the line and shape of a marble. Out of center, it will translate into out of shape, following the glass movement with one hand that rotates and another that holds the jacks.

In this recipe, the use of metaphors serves as a guideline to understand the objective of each stage without deepening in the instruction. It serves as part of what I reflected during the learning process and can help a novice focus on what is the central message of each stage of making a marble. With narratives and instructions, glassblowers perceive their movements and intend to transmit them as guidelines. Until it becomes innate, movement and body awareness play a decisive role in how one learns, accompanied by practice and general guidance. Reflecting on my learning process, I have gained mostly through seeing and through the use of drawings and representation of what it should look like—feeling, although, is not something possible to draw⁸⁸.

In the example below, we can analyze the glassblower Bibi Smit's instruction for beginners. Smit's experience in lecturing in various glass studios makes it possible to look deep into the practice. And to follow step by step, taking conscious of how the body should be positioned, the gestures, the technical procedures, and gestures of what is about to happen. In value, it informs the novice in the full process, which is commonly accompanied by drawing shapes. Her narrative is strong on glass knowledge, embedded in skill and intention to position herself in the body of the novice.

Gathering and Centring: Bibi Smit's Instruction

Gathering glass from the furnace is difficult, but when done correctly, it simplifies further shaping. Stabilize the pipe in the corner of the furnace mouth, or on the specially designed cornerstone or metal hook. Insert the pipe about 4 cm into the glass and rotate, keeping that depth, one full circle, turning clockwise. Then, whilst **SPEEDING** up the rotating, rise

⁸⁸ During the apprenticeship with Bibi Smit, she asked many times if I was feeling the glass differently. She would be interested in understanding my perception, body awareness and connection with touch. Many times, she asked to make the glass longer or thinner, blow soft, medium, stronger. All of these nuances were created in time, during the process, preserved in memory and focused attention. They behaved as guidelines written in a cloud; moving, fluid, graspable.

SLOWLY from the glass until the pipe is horizontal. Meanwhile, the pipe is still resting on the corner of the furnace's mouth. The intention is to collect as much glass as possible around the nose of the pipe. The secret lies in the relationship between the speed of the rotation and the rising of the nose of the pipe from the glass bath. The actual surface is where most of the glass is collected. The shape of the hot glass at the end of the pipe can be best described as a soft ice-cream, with the tail turned around at the end. When the pipe is horizontal, move the left hand forward toward the center of gravity of the pipe, and lift the pipe horizontally out of the furnace. From this moment on, keep turning slowly and evenly. Keep the rod horizontal when walking to the marver or chair. The immediate reflex of a beginning glassblower is to hold the pipe up in the air to stop the glass from falling off. This is not a good idea as it causes all the glass to collect around the pipe itself, and not in front of the pipe, where it is meant to be. Bringing the glass on the center is dividing it evenly around the center at the end of the pipe⁸⁹.

One particularly interesting fact is that instructions, written or spoken, serve to bring nuances that are difficult to transmit in practice or to acknowledge. Positioning little details together, helps the novice learn how the glass movement, but many times it is proven not to be enough. As an example, I have many times forgot about rotating my left hand, and has many times Bibi would tell me to remember the left hand, it appeared many times that when she touched my hand, I remember and became aware of it, which was not happening during spoken or written instruction. Her hand also behaved like a bodily instruction.

Analyzing the diffractive patterns between the novice and glassblower instruction, we find strong, although complementary, basis in the making and transfer process. They both communicate; one hand helps the other. The use of metaphors and stories, many times present in Smit's discourse, paint a different image of what is in need to be done and what an apprentice tends to do. Anticipating the steps and movements makes it possible to help knowledge transfer gain form. Lost in the making, we often find something. Worthwhile to notice that metaphors are subjective of interpretation; they can be interpreted in a way that was not intended. Instructions howbeit are less subjective to interpretation but can many times overlook some initial small steps. Understanding subjectivity brings to light new

⁸⁹ Smit wrote this instruction back in 1999.

forms to look into glassmaking and learning processes, transfers, and foremost reflect on glass's nature. A sense of wonder affords experimentation, making glass metamorphose endlessly.

All things considered, glassmakers, scholars, and experts are asked to make the language more flexible in order to share, discuss, and evoke embodied knowledge practices. Narratives and metaphors can help to evoke an experience, as they illustrate sensation and touch. By writing sensorial data (such as smells, touch and feeling), forms of intuition and anticipation, along with the glassblower's intentionality, curiosity, and perseverance, we look into the beauty and poetics of making; all of the nuances that make embodied knowledge a complex way of knowing and transferring.

Visualizations and Notation Systems

As a matter of principle, there is a dissimilarity between moving, vocabularies about movement and seeing movement. As I have discussed before, narratives and storytelling look upon how glass is performed through sensorial-based experience and touch. Its fundamentally different to see and to feel (either glass, tools and space) as they diverge in nature. Movement and gesture are best to be perceived through visualization and notation systems. Being able to see, even if it is in video recorded or through a set of signs and signifiers, allows for a better understanding of how the body is moving and expressing itself.

Visualizations highlight knowledge economy and recognition as they help grasp ephemeral practices. Musical and dance notation systems, such as Benesh, Laban notation, and the Sutton Movement Writing, to name a few, inform, record and can be used to transfer knowledge⁹⁰. When blowing, one is asked to use tools and instruments to shape. The same occurs when considering tools for knowledge transfer, that enhance and help to know. I will discuss how tools can be used to transfer embodied knowledge and thus, to make invisible practices available for novices.

90 Lise Bender Jørgensen, "Writing Craftsmanship? Vocabularies and Notation Systems in the Transmission of Craft Knowledge" in *Archaeology and Apprenticeship : Body Knowledge, Identity, and Communities of Practice*, edited by Willeke Wendrich, (University of Arizona Press, 2013): 245.

For Harald Høgseth, the high level of abstraction makes craftsperson's knowledge difficult to express⁹¹. Notation systems such as the Sutton Movement Writing use common signs to document, preserve and analyze movement and gestures. Endorsing Polanyi's tacit knowledge, Høgseth argues about representing movement patterns, action and rhythm can be a way to make 'non-discursive knowledge discursive', which can act as a way to preserve knowledge approaching extinction⁹². Such an argument carries a strong possibility to make visible invisible practices as it explores the positionality (body and space) and performativity (body and movement). Writing in favor of Pierre Bourdieu's *habitus* concept, Høgseth notes that knowledge is developed in the social space, in the interactions of individuals and networks, based on the dynamic process of exchange⁹³. It is important to stress here the complex and rich vocabularies and systems of craftsperson cannot be used in the same way as musical. I ask to reflect on possibilities of using such system may bring in transferring knowledge by creating a unified language of sign and signifiers. And also, to acknowledge the difficulty both in writing and creating signs/notation systems for embodied knowledge.

Reading through the glassblower's interviews, it is commonly agreed on the difficulty of having a universal language, as we must consider different working processes, studios, apparatuses, tools and notations. The glassblower Marc Barreda argues that language is required to be both refined and diverse, acknowledging detail and nuances in the making. By creating systems to see movement and translating it to another medium is a 'great way to translate a format like movement'⁹⁴. Differences in pronunciation and intonation, depending on the socio-cultural background, need to be acknowledged in order to be written. Writing vocabularies and signs may help build a stronger community of shared knowledge.

While notation systems may inform movement and gestures, visualizations may bring to the surface what was not possible to see – invisible, unaware, unconscious – before. In this sense, to see symbols of movement versus recorded movement aims to acknowledge movement's nature. Making a recording of a glassblower performing in the studio may inform both novice and the performer. The Corning

⁹¹ Harald Bentz Høgseth, "Knowledge Transfer: The Craftmen's Abstraction" in *Archaeology and Apprenticeship : Body Knowledge, Identity, and Communities of Practice*, edited by Willeke Wendrich, (University of Arizona Press, 2013): 61.

⁹² *Ibid.*, 95.

⁹³ *Ibid.*, 66.

⁹⁴ Barreda, in interview with the author. See Appendix 6.

Glass Museum, among others, has developed demonstrations and records of different teams, artists and glassmakers in action, showing both the process, techniques and explaining step-by-step what is happening. These demonstrations make theoretical glass knowledge accessible to audiences with shared enthusiasm. Although these visualizations bring recognition to practitioners, is nevertheless insufficient in explaining the complexity of what is happening at an individual level. An improved experimentation would be to consider how to record the tacit knowledge that seems to exist at the moment; and its ephemeral nature.

One of the crafted illustrations of experimental visualizations is the project *Synchronous Objects for One Flat Thing, reproduced* by William Forsythe⁹⁵. For James Leach, this experiment created a set of tools to visualize Forsythe's piece, making visible nuances of movement information⁹⁶. Drawing from deLahunta and Zuniga Shaw, Leach agrees that these data and animations form unique connections with other disciplines by creating 'a new level of generative relations', that can be transported outside contemporary dance⁹⁷. Equally important is how we discover unique ways of perceiving the choreography: one of the tables is never used. Digitalization, for example, approaches dance and other ephemeral processes as a way to discover and experiment⁹⁸. For the choreographer and scholar Maaïke Bleeker, *Synchronous Objects* unravels knowledge of twenty-two synchronous objects since it takes data from one particular choreography and makes us visualize it in different ways. It puzzles our thinking process about how technology looks at dance, and 'extracts knowledge out of the data from the dance in a radically different way'⁹⁹; some of these tools are very similar to human perception, while others stimulate unique experiences. More specifically, Bleeker is interested in questioning the relationship between digital technologies and dance, and developing systems for recording and transmitting that differ from traditional archives. As Bleeker puts it:

⁹⁵ See further <https://synchronousobjects.osu.edu/>.

⁹⁶ James Leach, "Making Knowledge from Movement: Some notes on the contextual impetus to transmit knowledge from dance" in *Transmission in Motion: The Technologizing of Dance* by Maaïke Bleeker (London: Routledge, 2016): 147.

⁹⁷ Ibid., 143.

⁹⁸ Viewed from this perspective, the analysis of human behaviour and movement require systems that integrate complex variables in the notation and transmission of dance. Writing in favour of Michel Foucault's concept of Heteropia, Sally Jane Norman suggests that digital technologies make possible at 'juxtaposing in a single real space several spaces, several sites that are themselves incompatible'. See further Sally Jane Norman, "Between Grammatization and Live Movement Sampling" in *Transmission in Motion: The Technologizing of Dance* by Maaïke Bleeker (London: Routledge, 2016): 185-198.

⁹⁹ Maaïke Bleeker (scholar, dramaturg), in interview with the author, 19 February 2020. See Appendix 5.

Dance has a history of dissatisfaction and discomfort with the traditional archive. This resistance is not resolved by digitalization. Rather, dance's resistance to fixation and how this inspires alternative approaches to knowledge transmission draws attention to mediality and performativity as fundamental aspects of how knowledge is transmitted, and also to how transformations brought about by digitalization highlight the intimate connection between conceptions of what it means to know and the media we use to store and transmit knowledge¹⁰⁰.

Although it was conceived as a conceptual piece, we could perceive *Synchronous Objects* as a teaching tool. By developing languages of recording that are fundamentally different from human perception, we stumble upon an aerial view of the movement, gestures, and intra-relations between dancers, tables and space. Worthwhile to notice that each individual dancer needs to memorize and transmit their knowledge – as an object. Video recording of these nature may influence how we learn and teach embodied knowledge. Whereas practice inhabits the physical presence, records can be accessed in unique positions and may inform details and nuances. Video recordings for analysis, record and knowledge transfer could thus be perceived, mainly, as tools for movement and gestures¹⁰¹.

We can infer from this that although glass knowledge requires a complex set of signs in notation systems, visualizations have the potential to help knowledge transfer, but also inform and build on that same knowledge. It is also important to analyze where visualizations and recordings find their limitations and strengths and adapt their language to different studios and glass techniques. We cannot smell burning newspaper or feel the heat, but we aim to perceive gesture and movement at different speeds, making it visible, which will translate into better *know-how*. Notation systems and

¹⁰⁰ Maaïke Bleeker, “What if this were an archive? Abstraction, enactment and human implicatedness” in *Transmission in Motion: The Technologizing of Dance* by Maaïke Bleeker (London: Routledge, 2016): 199.

¹⁰¹ During a visit at Royal Leerdam, I made some recordings of glassblowers working; in the time, they were blowing into a mold. While I was watching them, they moved from the bench to the mold part. The glassblower held the piece on top and blew the bubble, while the assistant opened and closed the mold; and then went back into the glory hole. Since the glassblower arms and mouth are occupied, many of them have developed a language to make the assistant open the mold, so the gaffer can take the piece out. When it was time to open, the gaffer tapped his right foot, and the mold opened. Only later, when I visualize the recordings, I understand the feet tapping the floor, which behaved as a signal for the assistant to know that was time to open. In the moment, since the movement was so fast and automatic, I was clueless about how they communicated. In this particular case, the video recording informed the movement by *slowing* it down and unraveling their communication.

visualizations thus can also bring recognition and unique uberous relations in glassmaking practices. We stumble upon making invisible worlds visible.

Sonification

In glassmaking, there is always a sound that inhabits space, moves through a plethora of rhythms and tempos, marking matters moving together. Depending on the level of expertise, sound plays an essential role especially for novices; it becomes data. The furnace running - *the heartbeat of the hotshop*¹⁰² - hums differently depending on the quantity of glass, the cold jacks squeak when molding, and a piece will break based on the sound of taking out the blowpipe. The question remains to be which sound represents which fate. To make matters more complicated, sound depends on many factors and auditory qualities of the vessels.

To give sound a stage in embodied knowledge transfer, many glassmakers and educators communicate what which sounds means. As an apprentice, I have learned through close looking at how relating tools and sounds informs what is necessary to be changed. In the cold and hot shop, sound plays a unique and distinct role¹⁰³. As an example, in polishing, we can perceive different noises based on what grinder is being used, if we move the piece circularly. Imagine that, using a 200 grain sounds similar to a train passing in a deck without making a stop; it goes vuum, vuum, vuum, vuum. Using a 325 grain¹⁰⁴ produces a humming sound, almost as the glass is singing¹⁰⁵. These sounds teach the glassmaker if the process is being performed correctly, and most importantly when it is at risk of breaking. Many glassmakers agree on the significance of hearing to know in the cold shop, contrary to during glassblowing where visual sight assumes a more significant role. According to Kelly, listening and being aware are linked in glass studio relations. In the cold shop, while gridding, she

¹⁰² Bibi Smit, in conversation with the author.

¹⁰³ An pioneering project regarding sound in the glass workshop is the *Makers Marks: Glass Whispers* by Lisa Naas and David Faleris. Their project combines interdisciplinary approach to sound and glassmaking, creating an open archive of sounds, and music compositions derived from glass. About the ongoing collaborative project, founded in 2015, see further <https://www.inconcertwithglass.com/>

¹⁰⁴ Just like sandpaper for woodcarving, the highest number equals a smaller grain.

¹⁰⁵ Kelly, in interview with the author. See Appendix 4.

could distinguish different grids by the sound they produce, but also know when it is finished polishing, as she could feel 'everything moving smoothness' and an even sound.

In *The Sonification Handbook* (2011), Thomas Hermann, Andy Hunt, and John G. Neuhoff propose an original approach to auditory systems of perception. Turning data into sound allows us to pick up information without we being aware of, which can be used beneficial as 'a primary interface for data transmission', because of 'its complexity, power, and flexibility'¹⁰⁶. More specifically, Hermann is interested in exploring the potential of multimodal perception and how sound can be used as a tool for coaching. By proposing sonification as an interdisciplinary research field, Hermann asks us to understand sonification in view to learn and discover; in this sense, data becomes the instrument. Because sonification and auditory display systems recognize several nuances in sound, they are being introduced in a variety of fields and scenarios. His enthusiastic view on how we perceive sounds carries a sense of being present and considers how in digital data, we could translate information through key sounds.

As a speculative approach to glassmaking, sonification can help novices, during practice and teamwork, to perceive information faster by translating data into sound; and, thus, learn by hearing. Using sensors to measure the glass temperature and reproducing it in sound, may help the novice achieve it better, especially when they are not working alongside glassblower. It is important to stress here that these two different approaches to sound convey the sensorial experience of the studios. On the one hand, we can learn from the sounds that are made from direct contact between tools and glass. On the other hand, we speculate a transmission of data into sound. Consider, for example, that when the glass drops to a temperature that may break the piece, a speaker reproduces the sound of ice breaking; the louder the sound, the more is needed to take the piece back into the glory hole to pre-heat. Sonification is thus unraveled in intra-actions of matters; we perceive the studio as a multi-sensorial experience, where sound, as a tool, is shaped to assume different natures, all of them informing the glassblower.

¹⁰⁶ Thomas Hermann, Andy Hund, John G. Neuhoff. *The Sonification Handbook* (Berlin: Logos Verlag, 2013): 73.

Conclusion

Based on the explorations above, it is certainly the case that understanding and transferring material-discursive forms of knowing are open-ended hypothesis necessary in glassmaking practices. In transference, we must consider all components of embodied knowledge and create exchange channels towards a simplified universal language. I have discussed the urgency of embodied knowledge to be accepted as a means to *know*, for validity and recognition, but also to be able to transfer knowledge of the past, that remains in the living memory of bodies. Acknowledging little nuances may inform how we teach and educate glassmaking, but also other embodied practices. Furthermore, it should be explored how digital technologies, such as augmented auditory reality and virtual reality, may inform glassblowers and enhance knowledge transfer when we can no longer be in the studio's physicality. It could be of great richness to map performativity and curriculum of different studios, institutions, and cultures, along with studying patterns among traditional and autodidact forms of learning. Further collaborations among practitioners, researchers, experts, artists, and historians are essential to developing a more comprehensive and coherent glass language, enriching the exchange between different fields that explore embodied knowledge practices.

Loss of embodied knowledge is a contemporary problem; it rests upon generations of knowledge that approach a period of extinction. As I understand it, embodied artistic practices, because of its complexity and rich nature, face many difficulties in exchange. Although we may perceive embodied knowledge approaching extinction, we must also foresee possibilities for experimentation and new creations in the making. Recording and transferring embodied knowledge is supported by the power of communities and rich complex cultures transversal to other problems we may face; embodied knowledge matters. Developing platforms of exchange and networks of practitioners may help create a greater connection among the things we create, as we grow with other matters. Artistic practices may help to connect generations of expertise and build stronger communities based on traditions of *making*. But also, consider how we have become experts in new technologies, relating ourselves with the things we use.

In light of what was discussed, it is significant to take into account the reality of Royal Leerdam closing. After centuries of practice, glassblowers have come and gone, from younger generations to masters, moved along designs and artists collaborations. Haanstra's poetic view on glassblowing has ended, and with it, the intergenerational embodied knowledge of many. It plays a key role in

connecting a community of glassmakers and the end of an era. Walking in the empty space of the factory resembles moving in a space inhabited by sorrow and loss. It did not close from one day to another; it has moved into a slow disintegration. Walking the steps of many, we see hundreds of blowpipes, some very crooked with traces of blue ink. On the other side, a curtain of plastic waves through a broken window. Wood blocks everywhere, with every form, size and shape; some wet in the water waiting to be used, some wrecked by time. Those that stay until the end carry a sadness that can be felt through their eyes, their memory, and unrecognizable knowledge. We only find dusty glass, clusters of time, pieces, and rusted metals. The colored floor, made in yellow, red and blue, is now a remembrance of many steps and movement lines, breath takers and makers that have been linked to what I have tried to portray; it has become a space without bodies.

Bibliography

- Barad, Karen. 2007. *Meeting the universe halfway : quantum physics and the entanglement of matter and meaning / Karen Barad*. Durham, NC, [etc.]: Duke University Press.
- Barad, Karen. 2003. "'Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter'." *Signs*, 28 (3) 801-831.
- Bleeker, Maaïke. 2016. *Transmission in Motion: The Technologizing of Dance*. London: Routledge.
- . 2007. "Knowing as Distributed Practice: Twenty-first Century Encounters with the Universe." *Transversal Practices: Matter, Ecology and Relationality*, April: 1-12.
- Collins, H. M. 2010. *Tacit and Explicit Knowledge*. Chicago: University of Chicago Press.
- Deirdre Heddon, Carl Lavery, Phil Smith, Roberta Mock. 2009. *Walking, Writing and Performance: Autobiographical Texts*. Bristol: Intellect Books.
- Gehm, Sabine, Pirkko Husemann, and Katharina von Wilcke. 2007. *Knowledge in motion : perspectives of artistic and scientific research in dance*. Bielefeld : Transcript.
- Hayles, N. Katherine. 1999. "Toward Embodied Virtuality." In *How We Became Posthuman : Virtual Bodies in Cybernetics, Literature, and Informatics*, by N. Katherine Hayles, 1-24. Chicago: University of Chicago Press.
- Illgner, Amalia. 2016. "Raiders of the lost crafts." *Independent*. 24 September. Accessed January 27, 2020. <https://www.independent.co.uk/extras/lifestyle/raiders-of-the-lost-crafts-a7324826.html>.
- Inagaki, Tatsuo. 2010. "Fieldwork as Artistic Practice." In *Between Art and Anthropology: Contemporary Ethnographic Practice*, by Christopher Wright Arnd Schneider, 75-81. New York: Berg.
- Kirschner, Roman. 2017. *The Coupling of Matter and Imagination in Fluid Ecologies*. Berlin, Boston: De Gruyter, Inc.
- Kneebone, Roger. 2018. "Getting back in touch." *Lancet*, Vol: 391 1348-1348.
- . 2018. "In praise of boredom." *Lancet*, Vol: 392 725-725.
- . 2019. "Looking and seeing." *Lancet*, Vol: 393 1091-1091.
- . 2019. "The vanishing art of doing." *BMJ Publishing Group*, Vol: 364.

- Lisa Naas, David Faleris. 2019. "Makers Marks: Capturing, Preserving, and Sharing the Sounds of Glassmaking." *Arts* 1-20.
- Maaike Bleeker, Iris van der Tuin. 2014. "Science in the performance stratum: hunting for Higgs and nature as performance." *International Journal of Performance Arts and Digital Media* 232-245.
- Maggi Savin-Baden, Katherine Wimpenny. 2014. *What Are arts-related methods?* Rotterdam, Boston: Sense Publishers.
- Marie Louise Stig Sorensen, Katharina Rebay- Salisbury. 2012. *Embodied Knowledge: Historical Perspectives on Belief and Technology*. Havertown: Oxbow Books.
- Merleau-Ponty, Maurice. 2012. *Phenomenology of Perception*. Abingdon, Oxon; New York : Routledge.
- Neil Gascoigne, Tim Thornton. 2013. *Tacit Knowledge*. Durham: Acumen.
- Noë, Alva. 2016. "Newman's note, entanglement and the demands of choreography: Letter to a choreographer." In *Transmission in Motion: The Technologizing of Dance*, by Maaike Bleeker, 228-236. London: Routledge.
- O'Connor, Erin. 2005. "Embodied Knowledge: The experience of meaning and the struggle towards proficiency in glassblowing." *SAGE Publications* 183-204.
- O'Connor, Erin. 2015. "Inter- to intracorporeality: the haptic hotshop heat of a glassblowing studio." In *Studio Studies: Operations, topologies and displacements*, by Alex Wilkie Ignacio Farías, 105-119. London, New York: Routledge.
- O'Connor, Erin. 2017. "Touching tacit knowledge: handwork as ethnographic method in a glassblowing studio." *Qualitative Research: SAGE Journals* 217-230.
- Polanyi, Michael. 1958. *Personal Knowledge: Towards a post-critical philosophy*. London: Routledge & Kegan Paul Ltd.
- Roger Kneebone, Abigail Woods. 2014. "Recapturing the History of Surgical Practice Through Simulation-based Re-enactment." *Medical history* 58(1) 106-121. Accessed Dec 11, 2019. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3866005/>.
- Sabine Gehm, Pirkko Husemann, Katharina von Wilcke, Tanzkongress Deutschland. 2007. *Knowledge in Motion: Perspectives of Artistic and Scientific Research in Dance*. Bielefeld : Transcript.

- Saukko, Paula. 2003. "Studying Multiple Sites and Scapes." In *Doing Research in Cultural Studies: An introduction to classical and new methodological approaches*, by Paula Saukko, 176-196. London: Sage Publications.
- Sennett, Richard. 2008. *The craftsman / Richard Sennett*. New Haven [etc.]: Yale University Press.
- . 2012. *Together: The Rituals, Pleasures and Politics of Cooperation*. London: Penguin Books.
- Serres, Michel. 2015. *Thumbelina: The Culture and Technology of Millenials*. London: Rowman & Littlefield International.
- Tanaka, Shogo. 2011. "The notion of embodied Knowledge." In *Theoretical Psychology: Global Transformations and Challenges*, by Paul Stenner, 149-157. Ontario: Captus Press Inc.
- Thomas Hermann, Andy Hund, John G. Neuhoff (Eds.). 2011. *The Sonification Handbook*. Berlin: Logos Verlag.
- Wendrich, Willeke. 2013. *Archaeology and Apprenticeship : Body Knowledge, Identity, and Communities of Practice*, edited by Willeke Wendrich. Los Angeles: University of Arizona Press.